Amendments to the Specification

The paragraph starting at page 1, line 25 has been amended as follows.

An image printing apparatus of a so-called serial scan type, which executes the print operation while scanning a print head, or a printing unit, over a print medium, has found a variety of image forming applications. The ink jet printing apparatus in particular has in recent years achieved high resolution and color printing, making a significant image quality improvement, which has resulted in a rapid spread of its use. Such an apparatus employs a so-called multi-nozzle head that has an array of densely arranged nozzles for ejecting ink droplets. Images with still higher resolution ~~has~~ have now been made possible by increasing the nozzle density and reducing the amount of ink per dot. Further, to realize an image quality approaching that of a silver salt picture, various technologies have been developed, including the use of pale or light color ink with reduced concentration in addition to four basic color inks (cyan, magenta, yellow and black). A print speed reduction problem, which is feared to arise as the picture quality advances, is dealt with by increasing the number of print elements, improving the drive frequency and employing a bi-directional printing technique, thus realizing a satisfactory throughput.

The paragraph starting at page 5, line 17 has been amended as follows.

In other technologies, such as ~~USP 4920355~~ U.S. Patent No. 4,920,355 and Japanese Patent Application Laid-Open No. 7-242025 (1995), ~~a~~ high resolution printing is

realized by setting the paper feed distance for each print scan to a predetermined number of pixels less than the length of the column of nozzles while leaving the multi-nozzle arrangement at a low resolution. Such a printing method is hereinafter called an interlace printing method.

The paragraph starting at page 7, line 16 has been amended as follows.

Many proposals have been put forward as to the method of correcting ink landing position deviations among different colors and, in the bi-directional printing, the method of correcting deviations in ink landing position of the same color between the forward scan and the backward scan. However, as for the correction of the ink landing position deviations between the rasters of the same color produced by the head shown in Fig. 28A, an effective adjustment method has yet to be proposed although the allowable range for the deviation is narrow and the effects of such ~~the~~ deviations on the image formation are large. Further, the deviation in ejection direction between the even-numbered nozzle column and the odd-numbered nozzle column is caused by the ink composition, ink ejection history such as ejection frequency, and printing environment, as well as the characteristic variations of individual heads. Therefore, even if the ink ejection timing for a head is determined which does not cause ink landing position deviations under a particular condition, that ejection timing cannot be applied to all circumstances. That is, not only should the ink ejection timing be adjusted before shipping according to the characteristic variations of individual heads, it is also strongly called for that the

adjustment be able to be made as required according to the history of use. Without these demands being met, it is difficult to form a high quality image at all times.

The paragraph starting at page 9, line 19 has been amended as follows.

Further, in the bi-directional printing, in particular, the higher the resolution of the image, the more stringent the required dot landing position accuracy becomes, so that a dot landing position deviation of even several μm will result in a perceivable degradation of image quality and, therefore, another object of the present invention is to make it possible to set the dot position adjustment value properly and in real time according to characteristic variations, within tolerance, of the print head and the printer body as well as according to the state of the printing operation.

The paragraph starting at page 26, line 22 has been amended as follows.

Fig. 32 shows an example of an adjustment value table ~~of~~ for registration using the relationship of Fig. 30;

The paragraph starting at page 27, line 1 has been amended as follows.

Fig. 34 is an example of an adjustment value table ~~of~~ for registration considering the temperature changes of the print head;

The paragraph starting at page 27, line 12 has been amended as follows.

Fig. 37 is an example of an adjustment value table ~~of~~ for registration using the relationship of Fig. 36.

The paragraph starting at page 28, line 3 has been amended as follows.

The word "print medium" or "print sheet" ~~include~~ includes not only paper used in common printing apparatus, but cloth, plastic films, metal plates, glass, ceramics, wood, leather or any other material that can receive ink. This word will be also referred to as "paper".

The paragraph starting at page 35, line 25 has been amended as follows.

Figs. 6A and 6B show the scanner M6000 ~~upside down~~ upside-down to explain ~~about~~ its outline construction.

The paragraph starting at page 43, line 2 has been amended as follows.

In the figures, reference number E2002 represents a PLL controller which, based on a clock signal (CLK) E2031 and a PLL control signal (PLLON) E2033 output

from the CPU E1001, generates a clock (not shown) to be supplied to ~~the~~ most ~~part~~ of the components of the ASIC E1006.

The paragraph starting at page 48, line 21 has been amended as follows.

Denoted E2022 is a sensor signal processing unit which receives detection signals E1032, E1025, E1026 and E1027 output from the PG sensor E0010, the PE sensor E0007, the ASF sensor E0009 and the gap sensor E0008, respectively, and transfers ~~these~~ this sensor information to the CPU E1001 according to the mode determined by the CPU E1001. The sensor signal processing unit E2022 also outputs a sensor detection signal E2052 to a DMA controller E2021 for controlling the LF/PG motor.

The paragraph starting at page 50, line 16 has been amended as follows.

Next, ~~steps~~ step S4 waits for an event. That is, this step monitors a demand event from the external I/F, a panel key event from the user operation and an internal control event and, when any of these events occurs, executes the corresponding processing.

The paragraph starting at page 56, line 5 has been amended as follows.

This method will be explained by referring to Figs. 14A to 14C. Although the head 3001 is scanned three times as shown in Fig. 14A to complete the print in an area

similar to that shown in Figs. 12A-12C and Figs. 13A-13C, an area of four pixels, one-half the vertically arranged eight pixels, is completed with two scans (passes). In this case, the eight nozzles of the head 3001 ~~is~~ are divided into two halves, the upper four nozzles and the lower four nozzles, and the number of dots formed by one nozzle in one scan is equal to the image data culled to one-half according to a predetermined image data arrangement. During the second scan, dots are embedded at the remaining half of the image data to complete the print in the four-pixel area. This method of printing is called a multi-pass printing method. With this printing method, if a print head similar to the one shown in Fig. 13A is used, the individual nozzle influence on the printed image is halved, so that the printed image will be as shown in Fig. 14B, rendering the white lines or dark lines shown in Fig. 13B less noticeable. Hence, the unevenness in density is significantly improved as shown in Fig. 14C when compared with Fig. 13C.

The paragraph starting at page 67, line 12 has been amended as follows.

Figs. 19A and 19B are enlarged views of the bi-directional registration patterns and show how they are printed. A series of ~~adjustment~~ adjustments in this embodiment also performs the O/E registration at the same time. To prevent the dot formation position deviations between the even- and odd-numbered columns from affecting the pattern, the print data only exists in the even-numbered rasters. The even-numbered rasters are printed every other dot and this is a limit pixel pitch (distance) at which the overlapping between the adjoining dots does not occur. With this setting, it is

possible to make the printed image to react sensitively to a small dot formation position deviation.

The paragraph starting at page 71, line 8 has been amended as follows.

In the O/E registration and in the bi-directional registration, the appropriate adjustment value also changes according to the carriage speed and the gap. This embodiment has a mechanism that automatically carries out the registration according to ~~these~~ this information.

The paragraph starting at page 83, line 24 has been amended as follows.

The pattern digitized by the conditional decision making method used in this invention is characterized in that even when there are many conditions (rasters) to be adjusted, a pattern with slight deviations and a pattern with no deviations at all can be clearly distinguished. This pattern, although it is a single pattern that contains a plurality of adjustment conditions, can exhibit its intended smoothness only when all the conditions are met. Hence, the pattern area to be printed is the same whether the number of conditions ~~are~~ is two as in the above embodiment or four as in this embodiment.

The paragraph starting at page 86, line 14 has been amended as follows.

The above embodiment employs a method that automatically changes the adjustment value for bi-directional registration when the user intentionally switches the printing state, as by changing the gap amount to allow the use of a thick sheet such as an envelope or by increasing the carriage speed in a mode that ~~giveS~~ gives priority to the print speed.

The paragraph starting at page 90, line 11 has been amended as follows.

In this embodiment the ink ejection speed from the print head is set at 13 ± 3 ~~m~~ m/s. In this case, too, even if a uniform gap of 1.4 mm for example is obtained, the adjustment value for registration will deviate by as much as ± 2 to 3 pixels when the ejection speed is within the tolerance range. Considering this, it is strongly desired in practice that the registration processing be carried out to form a high quality image.

The paragraph starting at page 99, line 3 has been amended as follows.

A column F of Fig. 35 ~~is~~ includes adjustment patterns for a bi-directional registration. The patterns of column F of this embodiment ~~is~~ are also formed in the same manner as shown in Fig. 17 and ~~its~~ their adjustment range is between "+5" to "-5" as indicated by the adjustment values attached to the left of the pattern. The bi-directional registration pattern corresponding to the "0" (default) value is printed with a value that is obtained by the embodiment explained in Fig. 32.

The paragraph starting at page 107, line 10 has been amended as follows.

The storage media to supply the program codes include, for example, floppy disks, hard disks, optical disks, ~~optical disks,~~ CD-ROMs, CD-Rs, magnetic tapes, nonvolatile memory cards and ROMs.

The paragraph starting at page 108, line 22 has been amended as follows.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader ~~aspect~~ aspects, and it is the intention, therefore, ~~in~~ that the ~~apparent~~ appended claims ~~to~~ cover all such changes and modifications as fall within the true spirit of the invention.